Responsive Farming Using Wheat Agronomy

RESEARCH

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Location:
Minnipa Ag Centre

Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2010 Total: 410 mm
2010 GSR: 346 mm

Yield
Potential: 4.7 t/ha (W)
Actual: see article

Paddock History
2009: Wheat
2008: Wheat
2007: Wheat

Soil Type
Sandy loam to Sandy clay loam

Soil Test
Presented

Diseases
Moderate Rhizoctonia

Plot size
9 m x 1.5 m x 4 reps

Yield Limiting Factors
Nil

Resource Efficiency
Energy/Fuel use: standard
Greenhouse gas emmisions (CO_2, NO_2, Methane): standard

Social/Practice
Time (hrs): standard
Clash with other farmers operations: nil
Labour requirements: standard

Economic
Infrastructure/operating inputs: standard
Cost of adoption risk: standard
Market stability risk: standard

Key messages

In 2010 Axe sown 1 July produced a similar grain yield and gross margin to Wyalkatchem sown 11 June. These results continue to show that matching variety selection with sowing date can help to maximise profits.

Why do the trial?

It is critical in a region of low and variable rainfall, that the maturity range within wheat varieties is utilised to adapt to seasonal variability. A series of trials (EPFS Summary 2008 pg. 89 and 2009 pg. 105) have reported that matching wheat variety (maturity) selection to sowing date has achieved grain yield and quality benefits. 2010 is the third year of the study following below and above average rainfall seasons in 2008 and 2009 respectively. The results were also used to validate the Yield Prophet® decision support model.

How was it done?

A plot trial was established on 3 sowing dates (25 May, 11 June and 1 July) on paddock N1 at Minnipa Agricultural Centre. Axe (early maturity) and Wyalkatchem (early to mid season maturity) were sown with 55 kg/ha of DAP at 2 seeding rates (30 and 60 kg/ha) with and without urea (50 kg/ha) applied at Zadocks growth stage 31.The plots were 9 m x 1.5 m with 4 replicates. Plots received pre-emergent glyphosate and trifluralin and post emergent broad-leaf weed control.

Soil samples for chemical analysis were collected on 24 May 2010 and indicated nitrate and ammonium levels in the 0-0.1 m profile at 13 mg/kg, P at 24 mg/kg and soil organic carbon at 0.8%.

Soil moisture contents were taken at each seeding time, at anthesis and again at maturity (post harvest) from 1 treatment of each variety from each sowing time (Axe and Wyalkatchem sown at 60 kg/ha without applied urea). Biomass of each line was sampled at their specific anthesis dates. Plots were harvested and grain samples collected for yield and quality. Dates of measurements are listed with results.

Yield Prophet® simulations were completed at 4 times over the growing period 19 July, 4 and 24 August, and 27 September. Results calculated were restricted to the 3 times of sowing x 2 varieties x 2 seeding rates.

What happened?

The opening seasonal rains commenced on 23 May (totalling 63 mm over 6 days) allowing time of sowing 1 (TOS1) to go ahead on 25 May. TOS2 was sown on 11 June following 10 mm of rain. TOS3 was sown on 1 July following 17 mm rain during the previous week. A total of 69, 34, 27, 66, 68 and 72 mm of rain fell in May, June, July, August, September and October respectively. There was no recorded temperature below 2°C in 2010.

Soil water content at seeding, anthesis (flowering) and harvest for each variety and TOS in the 0-0.4 and 0.4-1 m soil profiles are presented in Table 1.

Time of sowing 1 had more available water at seeding than TOS2 and 3. TOS2 had more water retained at harvest than TOS3 in the 0-0.4 m profile. Wyalkatchem used more water between seeding and anthesis than Axe at TOS1 in the 0-0.4 m profile and in the 0.4-1 m profile at TOS2.

Table 1 Volumetric soil water content (mm) at seeding, anthesis and harvest in resonse to wheat variety and TOS in 0-0.4 and 0.4-1 m soil profile

			0-0.4 m		0.4-1 m	
			Axe	Wyalkatchem	Axe	Wyalkatchem
TOS1	Seeding	25 May	57	57	66	66
	Anthesis	24 September	33		67	
	Anthesis	27 September		26		56
	Harvest	20 September	29	26	47	49
TOS2	Seeding	11 June	28	28	46	46
	Anthesis	7 October	18		55	
	Anthesis	13 October		18		47
	Harvest	20 December	25	28	52	52
TOS3	Seeding	1 July	33	33	45	45
	Anthesis	18 October	24		39	
	Anthesis	21 October		22		39
	Harvest	20 December	23	22	42	45
LSD (P=0.05)			*4.2*		*6.7*	

Table 3 Yield Prophet® grain yield at 50% probability at approximate mid-tillering and anthesis growth stages with measured grain and calculated water use efficiency (kg/mm of plant available water) and gross margins ($/ha) in response to TOS and variety

TOS	Variety	Seeding Rate (kg/ha)	N Top Dressed (kgN/ha)	Yield Prophet®		Grain Yield (t/ha)	Water use efficiency (kg/mm**)	Gross Margin ($/ha#)
				Tillering*	Anthesis*			
				20 July	24 August			
1	Axe	60	0	2.5	3.0	2.8	13	799
1	Axe	60	50			3.3	15	830
1	Axe	30	0	2.5	2.8	3.1	14	930
1	Axe	30	50			2.8	13	799
1	Wyalkatchem	60	0	2.5	3.2	3.4	16	1,011
1	Wyalkatchem	60	50			3.3	15	941
1	Wyalkatchem	30	0	2.5	3.0	2.5	11	525
1	Wyalkatchem	30	50			2.8	13	576
				4 August	27 September			
2	Axe	60	0	0.8	3.2	2.8	17	585
2	Axe	60	50			2.6	15	711
2	Axe	30	0	0.8	3.0	3.2	19	688
2	Axe	30	50			2.7	16	766
2	Wyalkatchem	60	0	0.8	3.1	3.2	19	838
2	Wyalkatchem	60	50			3.6	22	937
2	Wyalkatchem	30	0	0.8	2.9	3.5	21	941
2	Wyalkatchem	30	50			3.5	21	914
				24 August	27 September			
3	Axe	60	0	1.5	3.1	4.2	26	1,139
3	Axe	60	50			3.6	22	925
3	Axe	30	0	1.4	3.1	3.1	19	811
3	Axe	30	50			3.4	21	872
3	Wyalkatchem	60	0	1.5	3.1	3.0	19	794
3	Wyalkatchem	60	50			3.0	18	748
3	Wyalkatchem	30	0	1.4	3.1	3.7	23	990
3	Wyalkatchem	30	50			3.1	19	794

**Decile increased from 5 to 6 over the period 20 July – 24 August and from 6 to 8 over the period 24 August to 27 September.*
***Water use efficiency calculated on rainfall measured between seeding and harvest, taking into account 110 mm of evaporation and changes in soil water content in the 0-1 m soil profile.*
#Gross income is yield x price (with quality adjustments) less seed costs delivered to cash pool on 5 January 2011, Port Lincoln. Grades were adjusted according to screenings and test weight. $350/t used for seed value.

Table 2 Wheat plant numbers (plants/m^2), biomass at anthesis (tDM/ha), grain yield (t/ha), protein (%) and test weight (kg/hectolitre) in response to TOS, variety, seeding rate and the addition of top-dressed nitrogen

TOS	Variety	Seeding Rate (kg/ha)	Top Dressed (kgN/ha)	Plant Number (plts/m^2)	Biomass at antheisis (tDM/ha)	Grain Yield (t/ha)	Grain protein (%)	Test Weight (kg/hL)
1				54	1.0	3.0	11.8	74.1
2				82	1.1	3.1	11.2	75.5
3				98	0.9	3.4	10.7	76.8
LSD (P=0.05)				*11.0*	*0.13*	*0.19*	*0.27*	*NS*
	Axe			80	0.8	3.1	11.4	75.1
	Wyalkatchem			77	1.2	3.2	11.0	75.9
LSD (P=0.05)				*NS*	*0.10*	*NS*	*0.30*	*NS*
1	Axe			56	0.7	3.0	11.8	74.2
1	Wyalkatchem			52	1.1	3.0	11.8	73.9
2	Axe			86	0.8	2.8	12.0	77.0
2	Wyalkatchem			80	1.4	3.4	10.5	77.0
3	Axe			97	0.9	3.5	10.5	77.0
3	Wyalkatchem			97	1.0	3.2	10.8	77.0
LSD (P=0.05)				*11.8*	*0.10*	*0.25*	*0.18*	*0.62*
Seeding rate x top dressed N		60	0	100	1.0	3.2	11.3	75.6
		60	50	90	1.1	3.2	11.1	75.5
		30	0	64	1.0	3.2	11.3	75.5
		30	50	60	1.0	3.1	11.3	75.3
LSD (P=0.05)				*13.3*	*NS*	*NS*	*NS*	*NS*
1	Axe	60	0	65	0.7	2.8	11.8	74.0
1	Axe	60	50	56	0.7	3.3	11.4	74.2
1	Axe	30	0	47	0.8	3.1	12.0	74.6
1	Axe	30	50	56	0.7	2.8	11.8	74.2
1	Wyalkatchem	60	0	61	1.2	3.4	12.0	74.7
1	Wyalkatchem	60	50	61	1.3	3.3	11.9	74.3
1	Wyalkatchem	30	0	52	1.1	2.5	11.8	73.3
1	Wyalkatchem	30	50	36	1.0	2.8	11.8	73.4
2	Axe	60	0	122	0.7	2.8	12.2	73.3
2	Axe	60	50	91	0.8	2.6	11.8	74.5
2	Axe	30	0	72	0.8	3.2	12.0	73.9
2	Axe	30	50	61	0.9	2.7	12.2	74.3
2	Wyalkatchem	60	0	106	1.5	3.2	10.4	77.5
2	Wyalkatchem	60	50	94	1.5	3.6	10.3	76.9
2	Wyalkatchem	30	0	65	1.3	3.5	10.7	77.4
2	Wyalkatchem	30	50	55	1.5	3.5	10.4	76.4
3	Axe	60	0	119	0.8	4.2	10.4	76.5
3	Axe	60	50	113	0.9	3.6	10.8	77.5
3	Axe	30	0	78	0.9	3.1	10.5	77.3
3	Axe	30	50	75	0.8	3.4	10.3	76.6
3	Wyalkatchem	60	0	125	1.0	3.0	10.9	77.5
3	Wyalkatchem	60	50	124	1.1	3.0	10.6	75.5
3	Wyalkatchem	30	0	72	1.0	3.7	10.8	76.8
3	Wyalkatchem	30	50	76	0.9	3.1	11.0	77.0
LSD (P=0.05)				*15.7*	*0.20*	*0.30*	*0.30*	*1.11*

Plant numbers that established increased at each of the 3 times of sowing and as a result of sowing at 60 kg/ha, compared to 30 kg/ha. Biomass production at anthesis was less at TOS3 than TOS2 and generally higher from Wyalkatchem than Axe. Grain yields were higher at TOS3 than TOS2 and 1, Wyalkatchem produced higher grain yield than Axe at TOS2 and vice versa at TOS3. Grain protein results were closely correlated with grain yields. There was no production or grain quality response to seeding rate or top-dressed nitrogen. Grain screenings were all less than 3% and not reported. Test weights were higher at TOS2 and 3 than TOS1.

Yield Prophet® simulations underestimated grain yield at early tillering based on a decile 5 to 6 scenario but were more accurate at anthesis with decile 8 conditions. Water use efficiency estimates increased with the later time of sowings in response to reduced growing season rainfall. Estimated gross margins reflect quality, yield and variable cost differences with treatments.

What does this mean?

The results were influenced by low numbers of establishing plants at TOS1, this was due to high mouse numbers that at subsequent TOS2 and 3 had an increasing availability of alternative feed sources over the 6 week seeding period. This may have been a factor in the later 1 July TOS3 being the highest yielding, however the above average August-October rainfall was a factor that affected this result. Soil water content results suggest TOS2 may have had a deficit at anthesis.

The two varieties used performed as expected with the early maturing Axe yielding higher from the final time of sowing, compared to Wyalkatchem (early to mid season maturity), which was higher yielding from TOS2. Although pre-seeding measured soil N was quite low there was no response to top-dressed urea. The response to seeding rate was only in plant numbers with no production benefit, or negative, between 60 to 100 plants/m^2.

Gross margins were all quite similar irrespective of TOS or variety but Axe at TOS3 and Wyalkatchem at TOS2 were the leaders.

The results from the above average rainfall season of 2010 do vary somewhat from the previous years studies EPFS Summary 2008 and 2009 “Responsive Farming Using Wheat Agronomy”. The 2010 trials indicated a late sowing benefit with a shorter season variety (Axe) as opposed to the early sowing benefits of previous studies. However low plant numbers established at TOS1 and less available water at the TOS2 anthesis time may have reflected in the grain yields.

These results continue to show that matching variety selection with sowing date can help to maximise profits.

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